Optical switching applications of ZnSe/MgF2 photonic band gap structures based on thermal nonlinearities

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We designed and realized a ZnSe/MgF_2 multilayer structure deposited on silicon heaters, in order to obtain the modulation of its optical reflectance near the band edge. An electrically induced temperature increase can be electrically applied to the resulting device and, therefore, a change in the refractive index of the layers is produced. As a result the band edge is red-shifted and the absolute signal is decreased. The particular design of the substrate, allow the application of a temperature increase to the multilayer stack by means of an applied current to the underlying heater. The proposed structure works in reflectance and allows the optical switching of the incident beam when the heating is activated.

Specifically, we fabricated a one-dimensional photonic band gap structure based on ZnSe [1,2]. The multilayer stack was deposited by thermal evaporation over the optical-active area of the silicon wafers. The layers stack is composed by 8 periods of ZnSe/MgF_2. From the optical point of view, the reflectance spectrum presents a band-edge at 628 nm, i.e. accessible to a low power He-Ne laser. The reflectance spectra have been measured under different applied voltage and a maximum shift of 7 nanometers has been observed, corresponding to a signal reduction of nearly 40% of initial value.

As a conclusion, we show experimentally that the combined use of a high thermal nonlinearity in a multilayer stack included in a electrically heated structure, result in strong variation of the reflected light intensity. This structure offers large potentiality for optical switching applications

[1] A.E.Gumlich, D.Theis and D.Tschierse, “Zinc Selenide” in *“Numerical Data and Functional Relationships in Science and Technology”* Landolt and Börnstein NS III 17b (1982).

[2] B.S.Wherret, A.K.Darzi, Y.T.Chow, B.T.McGuckin, E.W.Van Stryland, *J. Opt. Soc. Am.B* **7**,2 (1990).